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Body Mass Index and Waist Circumference Improvement Via Tabata Workout: A 10-Week Repetition Program

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Abstract: *Published scholarly works have accentuated the effectiveness of the TABATA workout for college students. However, no studies were conducted on college students in the context of higher education institutions in the Philippines. Ergo, this study aimed to assess the effectiveness of the TABATA workout for college students. Lastly, it aimed to investigate if such a method may help to improve participants' Body Mass Index and Waist Circumference. This investigation employed an experimental approach to assessing the effectiveness of TABATA training for college students. Moreover, students underwent a 10-week-long workout in repetition. The first part is focused on collecting participants' demographic characteristics such as sex, age, BMI (pre- and post-test), and WC (pre- and post-test). In the second part, the Physical Activity Readiness Questionnaire was used. Paired samples t-test was also used to determine the significant variance after 10-weeks based on participants' BMI and WC scores After the 10-week exercise performed by the participants in general, it was found that there is a reduction and improvement on participants' BMI. Additionally, an improvement in participants' WC. However, based on sex, no significant variance in males' BMI. Fascinatingly, an improvement was observed in the WC of both sexes. Based on the findings, participating in the TABATA program is effective and may partially improve students' BMI and enhance WC. This study did not take into account other factors which may also affect the result of this study. Therefore, comparable experiments may be conducted while taking into account other variables aforementioned to this study's limitation.*

Keywords: *Body Mass Index, College students, HIIT, Tabata Workout Exercise, Waist Circumference.*

INTRODUCTION

Overweightness and obesity have been a predictor of morbidity and mortality from cardiovascular diseases (CVD), diabetes, musculoskeletal disorders, and various types of cancer (Lopez-Jimenez et al., 2022; Piché et al., 2020). In addition, excess abdominal obesity is highly linked to a range of metabolic abnormalities and CVD (Amato et al., 2013; Tran et al., 2018). As a long practice, Body Mass Index (BMI) is widely used in the diagnosis of overweight and obesity (Nuttall, 2015; D. Shah & Sachdev, 2011; Taieb et al., 2022), whilst Waist Circumference (WC) and indices based on WC-such as the waist-to-hip ratio (WHR), and waist-to-height ratio (WThR) are utilized as surrogate indicators of visceral obesity in predicting morbidity and mortality at the population level (Ashwell & Gibson, 2016; Ferreira-Hermosillo et al., 2014; Yoo, 2016). Such anthropometric indices are applied in epidemiological studies for population surveillance of risk factors for chronic diseases because they can be easily measured and are low-cost (Bhatti et al., 2021; Golia et al., 2020). For example, in the study of Tran et al. (2018) in Vietnam, it was found that the measurements of BMI and WC are highly correlated (men r = .80, women, r = .77). For men, WC or an index based on WC is predominantly and highly associated with blood pressure, glucose, and total cholesterol, compared to their counterpart which is highly associated with glucose but highly important for BP and TC. In this regard, avoiding these possibilities by taking into consideration the BMI and WC of individuals at a young age, is highly recommended.

The college environment represents a critical space for young adults regarding the adoption of unhealthy eating habits and a greater risk of overweight and obesity, and even anemia, characterized particularly by an intake of foods rich in saturated fat and deficient in essentials minerals such as iron and folic acid (Quiliche Castañeda et al., 2021).

The prevalence of overweight and obesity has doubled in the last decades and affects almost a third of the world's population, especially among students in developed countries (Chen et al., 2020), such as the Philippines. Additionally, there has been a strike on the percentage of college students who are not physically active (Chaabna et al., 2022; Kljajević et al., 2021) which is highly evident on a global scale due to some reasons such as academic workloads, lack of self-discipline, and poor access to sports facilities (Ferreira Silva et al., 2022; Memon et al., 2021; Winpenny et al., 2018). In this regard, the aforementioned reasons above are considered a public health problem and a pandemic (Meldrum et al., 2017; Tanucan et al., 2022).

Schools such as higher educational institutions have long been identified as important venues for the provision of physical activities, especially during physical education classes (Kahan & McKenzie, 2015; Prevandos & Martin, 2022). As students spend a lot of time in school, most especially those who are pursuing their undergraduate degrees, educational institutions represent an appropriate setting and opportunity to implement interventions that focus on a healthy active lifestyle (Wyszyńska et al., 2020). Various scholars have accentuated those educational institutions, and specifically the course Physical Education, has an important role in the curriculum in mitigating overweight and the 'obesity epidemic' (Kahan & McKenzie, 2015; McKenzie & Lounsbery, 2014; Quennerstedt et al., 2021). Resources for educational purposes, programs, and special teaching strategies have been developed in various nations in an attempt to encourage young adolescents to practice an active healthy lifestyle targeting the reduction of overweightness and obesity problems (Alfrey, 2023; Cale et al., 2014).

One of the activities that are being provided to college students is HIIT activities such as TABATA workouts. In recent years, there have been numerous studies that were already conducted on the effectiveness of TABATA workouts in the improvement of individuals' overall health (Ekström et al., 2019; Li et al., 2023; Popowczak, Rokita, Koźlenia, et al., 2022). TABATA training is highly considered as one of the high-intensity 'interval or intermittent' training (HIIT) methods, which varies in terms of the characteristics of the training exercise (i.e., the exercise mode, intensity, and durations of exercise and rest) (Emberts et al., 2013; Tabata, 2019). This training also aims to yield the most benefits in a short amount of time. Such as for example, in each exercise, an individual may perform eight rounds of 20 seconds of strenuous exercise followed by 10 seconds of rest. HIIT is the 'near maximal' (in another term, 'submaximal') effort which is generally performed at an intensity that elicits > 80% (sometimes 85-95%) of the maximal heart rate (Weston et al., 2014). On the one hand, a broader definition of HIIT was suggested in which it typically involves short bursts of high-intensity exercise to which a short period of rest and recovery will follow which approximately takes < 30 min to execute (Thompson, 2023). In the exercise physiology discipline, the level of intensity of a specific exercise has been defined relative to the VO2max as 'submaximal,' 'maximal,' and 'supramaximal' when the oxygen demand is less than, equal to, and greater than VO2max, respectively. Since TABATA training is higher than the VO_{2max} (i.e., 170% VO_{2max}), the original training is 'supramaximal intensity intermittent training.' Furthermore, in terms of exercise: recovery ratio, TABATA is different from other exercises such as sprint interval training (SIT). In this regard, this training is an original and unique training method that can be described by either the classic but familiar term 'interval training' or the modern and "cool" term 'HIIT,' which includes a variety of training methods using intermittent/interval high-intensity exercise (Tabata, 2019).

Fascinatingly, it was found out that such workouts may be of great benefit in the improvement of body mass index and waist circumference of students (Domaradzki et al., 2020; Lu et al., 2023; Meng et al., 2022; N. Shah & Purohit, 2020). Most notably, in some scholarly articles, the effects of multiweek HIIT such as TABATA workout were observed in overweight young people and in those with normal BMI and WC, the results indicated that improvements are highly effective for overweight and obese individuals (D'Amuri et al., 2021; Domaradzki et al., 2021; Espinoza Silva et al., 2023; Ouerghi et al., 2017). Additionally, there have been recent studies that have mentioned the effectiveness of TABATA training in the virtual environment. It was also that virtual TABATA training is highly effective in the improvement of the level of physical fitness and psychological well-being of student-athletes (Gani et al., 2023). Likewise, another study was conducted were it was also observed that online TABATA workout had a positive effect on the improvement of muscle mass, ankle strength (dorsiflexion), hip strength (abduction, flexion, extension, and external rotation), knee strength (extension and flexion), and balance (Y-balance test) in adolescents (Lee et al., 2021). However, these studies have not focused on the Body Mass Index and Waist Circumference, instead, they have focused on other physical fitness components (i.e., VO_{2max}, endurance, speed, power, and strength), and psychological well-being. On the other hand, after performing a thorough investigation of published scholarly

works that were conducted in relation to this topic in the setting of college students in the Philippines, no studies were detected. Furthermore, inquiries concerning the effectiveness of TABATA workouts for college students in the improvement of their body mass index and waist circumference are still undiscovered. Evaluating its effectiveness is highly beneficial, most especially for physical education teachers in the Philippines in tertiary education, disseminating its importance in the improvement of students' BMI and WC to prevent or lessen the current number of students who are overweight and obese.

Purpose of the Study

In this regard, this current study examined the effectiveness of the 10-week TABATA workout in repetition to college students based on their pre- and post-test scores, and evaluating the difference based on sex.

MATERIALS AND METHODS OF RESEARCH

Research Design

This current investigation employed an experimental design to evaluate the effectiveness of a 10-week TABATA workout in repetition to undergraduate students in the improvement of their Body Mass Indexes (BMI) and Waist Circumference (WC). It is a scientific method to which the study is conducted in a structured and methodical manner, focusing on its goal in achieving accuracy and formulating the most precise conclusion (Miller et al., 2020). As mentioned earlier, this study has used a sampling technique to which the participants are selected based on their characteristics that are highly suitable for this kind of investigation. In this regard, a selection criterion was formulated to obtain the most reliable and accurate data from the participants:

- enrolled in the course Physical Education 2 (Fitness Exercises [Exercise Program-based])
- must be at least 19 years old;
- can be either male or female; and
- no medical history;

Table 1 illustrates the demographic characteristics of the participants. Based on the table, most of the participants are female compared to male [(N_{female} = *22*(73.3%), N_{male} = *8*(26.7%)]. In terms of age, most participants are 20 years old, followed by 19 and 21 years old [(N_{20yo} = *14*(46.7%), N_{19yo} = *13*(43.3%), N_{21yo} = *3*(10.00%)], respectively with a mean of 19.67 years old.

Table 1. *Demographic Characteristics of the participants*

Variables	Items	*N*(%)
Sex	Male	*8*(26.7%)
	Female	*22*(73.3%)
Age (M=19.67)	19 years old	*13*(43.3%)
	20 years old	*14*(46.7%)
	21 years old	*3*(10.0%)

Note: M-Mean

Table 2 below illustrates the TABATA workout program that is designed based on the curriculum of the course to which students are asked to undergo. It also provides the step-by-step process where students are expected to perform in class. The said workout program will be performed by the students in a repetitive manner for the duration of 10-weeks.

Table 2. *10-week repetition TABATA workout program*

Workout	Instructions
High Knees	1. Start standing. 2. Run in place, driving the knees towards the chest. 3. Use arms and try and go as fast as you can. Complete as many reps as possible in 20 seconds at maximum effort, followed by 10 seconds of rest. Repeat eight times. Rest for one minute then continue on to the next move.
Sprawl	1. Start in a plank position. 2. Jump feet toward hands, dropping butt below knees and lifting torso up, and raising hands to chest level. 3. Jump feet back to plank position. That's one rep. Complete as many reps as possible in 20 seconds at maximum effort, followed by 10 seconds of rest. Repeat eight times. Rest for one minute then continue on to the next move.
Skaters	1. Start standing with feet hip-distance apart. 2. Jump to the right, landing on right foot and bringing your left leg behind body. 3. Jump back to the left, landing on left foot and bringing right foot behind body. That's one rep. Complete as many reps as possible in 20 seconds at maximum effort, followed by 10 seconds of rest. Repeat eight times. Rest for one minute then continue on to the next move.
Knee Tuck to Pushup	1. Start in a high plank position. 2. Jump knees between hands (or place sliders under feet, and pull knees forward in line with hands). 3. Return feet to plank position. 4. Bend elbows and lower into a pushup with control. That's one rep. Complete as many reps as possible in 20 seconds at maximum effort, followed by 10 seconds of rest. Repeat eight times. Rest for one minute then continue on to the next move.
Tuck Jumps	1. Start standing. 2. Jump straight up, tucking knees to your chest. 3. Land softly, and immediately repeat that move. That's one rep. Complete 20 seconds at maximum effort, followed by 10 seconds of rest. Repeat eight times. Rest for one minute.
Mountain Climbers	1. Start in a plank position. 2. Drive your knees toward chest, one at a time, as quick as you can. That's one rep. Complete as many reps as possible in 20 seconds at maximum effort, followed by 10 seconds of rest. Repeat eight times. Rest for one minute then continue on to the next move.
Squat Jump	1. Start standing with feet shoulder width apart, toes pointed forward, and weight in heels. 2. Lower down into a squat, and then drive through heels to reverse movement and jump up as high as possible. 3. Land softly back into the squat position. That's one rep. Complete as many reps as possible in 20 seconds at maximum effort, followed by 10 seconds of rest. Repeat eight times. Rest for one minute then continue on to the next move.
Burpees	1. Start standing. 2. Squat down to plant palms on mat. 3. Immediately, jump feet back into a plank position. 4. Perform a pushup. 5. Jump feet toward hands. 6. Push down through heels to rise up and jump into the air, bringing hands over head. 7. Land softly back on mat. That's one rep. Complete as many reps as possible in 20 seconds at maximum effort, followed by 10 seconds of rest. Repeat eight times. Rest for one minute then continue on to the next move.

Instruments and Data Gathering Procedure

The collection of data from the participants was successfully obtained by utilizing a two-parts questionnaire. The first part is focused on gathering the participants' demographic profile both sex, age, body mass index (BMI- for both pre- and post-test scores) and waist circumference (WC-for both pre- and post-test scores). Lastly, the *Physical Activity Readiness Questionnaire* (PAR-Q) was also utilized to determine the participants' current health status in order to identify and exclude the participants based on the selection criterion formulated for the investigation

Participants of the Study

The selected participants for the study are undergraduate students enrolled from two sections in the program of Bachelor of Physical Education in a higher education institution in Angeles City, Region III (Pampanga), Philippines. Additionally, the participants are currently enrolled in the course Movement Competency Training for the 1st Semester, the Academic Year 2022-2023. In this regard, the participants were selected using *Purposive Sampling* technique. This method of selecting participants is not based on statistical likelihood, but rather on the researcher's subjective estimation of which participants will yield the most informative data (Etikan, 2016). Ergo, a selection criterion has been formulated to ensure that the participants' data is as accurate as feasible. The following criteria are as follows:

1. Must be at least 19 years old on the time of the experimental study has been investigated;
2. Either male or female students;
3. Participants' class are held in the orthodox and virtual modality; and
4. No prior medical conditions.

Statistical Analysis

Obtained data from the participants were processed via *IBM Statistical Package for the Social Sciences version 27* (IBM SPSS 27). The demographic characteristics of the participants (i.e., age, gender, BMI and WC) were interpreted using descriptive statistical analyses such as *frequency* (*f*), *mean* (M) and *percentage* (%). Lastly, *Paired samples t-test* was performed to evaluate the significant variance in terms of BMI and WC based on gender after performing a set of TABATA workout in repetition for ten consecutive weeks (Ross & Willson, 2017).

Ethical Considerations

The participants for this experiment were provided a background concerning the study such as its objectives, the instruments to be used, and the variables that will be measured in the entire duration of the investigation. Furthermore, minor risks in participating in the study were also enumerated. Participants were asked to provide their written consent by agreeing on the statement provided on the questionnaire.

RESULTS OF THE RESEARCH

Table 3 depicts the pre-test reports in terms of body mass index and waist circumference of the participants with respect to sex. In terms of body mass index, most male participants are under the normal classification followed by obese [($N_{male(normal)} = 6(75.00\%)$, $N_{male(obese)} = 2(25.00\%)$], while most female participants are under normal classification followed by underweight [($N_{female(normal)} = 14(63.63\%)$, $N_{female(underweight)} = 8(36.36\%)$]. For waist circumference, most male participants are under low risk followed by high risk [($N_{male(low\ risk)} = 7(87.50\%)$, $N_{male(high\ risk)} = 1(12.50\%)$], while most female participants are under low risk followed by moderate risk [($N_{female(low\ risk)} = 21(95.45\%)$, $N_{female(moderate\ risk)} = 1(4.54\%)$].

Table 3. *Pre-test report in terms of sex vis-à-vis Body mass index and waist circumference*

	Body Mass Index (BMI) Classification		
Sex	*Underweight/UW* (%)	*Normal/N* (%)	*Obese/O* (%)
Male	-	6(75.00%)	2(25.00%)
Female	8(36.36%)	14(63.63%)	-
	Waist Circumference (WC)		
Sex	*Low Risk (%)*	*Moderate Risk (%)*	*High Risk (%)*
Male	7(87.50%)	-	1(12.50%)
Female	21(95.45%)	1(4.54%)	-

Table 4 displays the post-test reports in terms of body mass index and waist circumference of the participants with respect to sex. In terms of body mass index, most male participants are under the normal classification followed

by obese [($N_{male(normal)}$ = *7*(87.50%), $N_{male(obese)}$ = *1*(12.50%)]. Fascinatingly, of the original two participants who are obese, one of them achieved the normal classification after performing the TABATA workout. Meanwhile, most of the female participants are under the normal classification followed by underweight [($N_{female(normal)}$ = *12*(54.55%), $N_{female(underweight)}$ = *10*(45.45%)]. On the other hand, of the original fourteen participants who are normal, two of them became underweight after performing the TABATA workout. Furthermore, concerning waist circumference, most of the male participants are under the low-risk followed by high risk [($N_{male(low\ risk)}$ = *7*(87.50%), $N_{male(high\ risk)}$ = *1*(12.50%)]. Comparing these findings from the pre-test report in Table 4, no changes were observed after performing the TABATA workout. Lastly, all participants are under the low risk [($N_{female(low\ risk)}$ = *22*(100.00%)], indicating that out of the 21 original participants under this category, one from the moderate risk successfully improved her waist circumference by performing the TABATA workout.

Table 4. *Post-test report in terms of sex vis-à-vis Body mass index and waist circumference*

	Body Mass Index Classification		
Sex	*Underweight/UW* (%)	*Normal/N* (%)	*Obese/O* (%)
Male	-	7(87.50%)	1(12.50%)
Female	10(45.45%)	12(54.55%)	-
	Waist Circumference		
Sex	*Low Risk (%)*	*Moderate Risk (%)*	*High Risk (%)*
Male	7(87.50%)	-	1(12.50%)
Female	22(100.00%)	-	-

Table 5 illustrates the detailed comparison of all the participant's body mass index/classification and waist circumference/classification before and after performing the 10-week TABATA workout in repetition. As can be seen in the table, there is a slight improvement and reduction in the participants' body mass indexes and waist circumference. Fascinatingly, it can be seen that the male, an obese participant, has a slight reduction in his body mass index and an improvement in his waist circumference. On the one hand, it is alarming that there is a significant decrease in the body mass index and waist circumference for most female participants under the underweight category after performing the workout.

Table 5. *Detailed comparison of participants' BMI/Classification and Waist Circumference/Classification based on pre-test and post-test scores*

Pre-test				Post-test			
Participant	**Sex**	**BMI / Classification**	**Waist Circumference / Classification**	**Participant**	**Sex**	**BMI / Classification**	**Waist Circumference / Classification**
1	F	17.52 (UW)	30.00 (LR)	1	F	18.02 (UW)	32.00 (LR)
2	F	18.35 (UW)	25.00 (LR)	2	F	18.37 (UW)	27.00 (LR)
3	F	22.92 (N)	27.95 (LR)	3	F	23.05 (N)	26.35 (LR)
4	F	18.65 (N)	28.00 (LR)	4	F	19.05 (N)	26.50 (LR)
5	M	23.41 (N)	30.00 (LR)	5	M	23.30 (N)	27.00 (LR)
6	F	20.50 (N)	29.00 (LR)	6	F	21.20 (N)	27.00 (LR)
7	M	23.15 (N)	36.00 (LR)	7	M	23.45 (N)	34.00 (LR)
8	M	26.44 (O)	41.00 (HR)	8	M	25.02 (O)	38.00 (HR)
9	M	23.79 (N)	32.00 (LR)	9	M	22.25 (N)	29.00 (LR)
10	M	18.52 (N)	26.00 (LR)	10	M	18.60 (N)	26.00 (LR)

11	F	19.23 (N)	28.20 (LR)	11	F	18.06 (N)	27.00 (LR)
12	M	20.80 (N)	30.00 (LR)	12	M	21.25 (N)	28.00 (LR)
13	F	19.20 (N)	29.00 (LR)	13	F	18.50 (N)	26.00 (LR)
14	F	18.75 (N)	33.00 (MR)	14	F	18.25 (N)	30.00 (LR)
15	F	17.24 (UW)	24.00 (LR)	15	F	16.45 (UW)	23.00 (LR)
16	F	22.00 (N)	25.25 (LR)	16	F	21.75 (N)	24.50 (LR)
17	F	17.92 (UW)	23.00 (LR)	17	F	17.05 (UW)	23.00 (LR)
18	F	19.80 (N)	27.00 (LR)	18	F	19.00 (N)	26.25 (LR)
19	F	17.33 (UW)	23.00 (LR)	19	F	16.55 (UW)	23.25 (LR)
20	F	19.50 (N)	26.00 (LR)	20	F	18.50 (N)	25.00 (LR)
21	F	21.19 (N)	26.50 (LR)	21	F	20.20 (N)	25.25 (LR)
22	M	20.90 (N)	27.00 (LR)	22	M	19.50 (N)	26.00 (LR)
23	F	18.50 (N)	28.00 (LR)	23	F	17.25 (UW)	26.00 (LR)
24	F	18.59 (N)	29.50 (LR)	24	F	18.01 (UW)	28.00 (LR)
25	F	16.99 (UW)	23.50 (LR)	25	F	17.02 (UW)	23.00 (LR)
26	F	18.90 (N)	27.50 (LR)	26	F	18.50 (N)	27.00 (LR)
27	F	17.24 (UW)	23.50 (LR)	27	F	18.01 (UW)	23.00 (LR)
28	F	18.59 (N)	28.00 (LR)	28	F	18.00 (N)	27.00 (LR)
29	F	15.17 (UW)	23.00 (LR)	29	F	16.22 (UW)	22.00 (LR)
30	M	28.01 (O)	33.00 (LR)	30	M	27.59 (O)	30.00 (LR)

Note: Values are expressed as BMI(Classification): UW- Underweight, N- Normal, O- Obese; Values are expressed as Waist Circumference (Classification): LR- Low risk, MR- Moderate risk, HR- High risk.

Table 6 demonstrates the results of the paired *t*-test analysis. Overall, in the pre-test and post-test scores, a significant variance was observed which indicates that there is a significant reduction and improvement in the Body Mass Index (BMI) of the participants after performing the TABATA workout [$BMI^{a(pre)}$ (19.97 ± 2.87) and $BMI^{b(post)}$ (19.60 ± 2.76), $t(29) = 2.873$, $p = .008$]. Lastly, concerning the waist circumference of the participants, a significant difference was observed which indicates that after performing the TABATA workout, there is a reduction and improvement in the waist circumference of the participants [WC^{a} (28.10 ± 4.05) and WC^{b} (26.87 ± 3.42), $t(29) = 5.124$, $p < .05$]. Moreover, the study has also examined the variance specifically the individuality of each sex. Concerning male participants, no significant variance was observed concerning their pre-test and post-test scores concerning BMI [$BMI^{a(pre)}_{male}$ (23.13 ± 22.62) and $BMI^{b(post)}_{male}$ (22.62 ± 2.92), $t(7) = 1.738$, $p = .126$]; on one hand, a significant variance was observed in terms of their waist circumference, indicating that there is a significant reduction and improvement in their WC after performing the TABATA workout [WC^{a}_{male} (31.88 ± 4.88) and WC^{b}_{male} (29.75 ± 4.23), $t(7) = 5.338$, $p = .001$]. For female participants, a significant difference was observed in their pre-test and post-test scores concerning BMI [$BMI^{a(pre)}_{female}$ (18.82 ± 1.75) and $BMI^{b(post)}_{female}$ (18.50 ± 1.72), $t(21) = 2.238$, $p = .036$]; also, a significant variance was observed in terms of their waist circumference, positing that there is a significant reduction and improvement in their WC after performing the TABATA workout [$WC_{female}{}^{a}$ (26.72 ± 2.70) and $WC_{female}{}^{b}$ (25.82 ± 2.43), $t(21) = 3.410$, $p = .003$].

Table 6. *Difference between pre-test and post-test, and waist circumference of participants*

	Variables	Paired Differences				t	df	Sig.
		M ± SD	SE	95% Confidence Interval of the Difference				
				Lower	Upper			
Overall								
1	BMI[a(pre)] - BMI[b(post)]	.37 ± .71	.130	.10689	.63510	2.873	29	.008
2	WC[a] - WC[b]	1.22 ± 1.31	.240	.73705	1.7162	5.124	29	.000
Male Participants								
1	BMI[a(pre)] - BMI[b(post)]	.51 ± .83	.292	-.18298	1.1979	1.738	7	.126
2	WC[a] - WC[b]	2.13 ± 1.12	.398	1.184	3.066	5.338	7	.001
Female Participants								
1	BMI[a(pre)] - BMI[b(post)]	.32 ± .67	.143	.02269	.62003	2.238	21	.036
2	WC[a] - WC[b]	.90 ± 1.24	.264	.35115	1.4488	3.410	21	.003

Note: Values are expressed as Mean ± Standard Deviation; BMI-Body Mass Index (pre- and post-test) WC- Waist Circumference (pre- and post-test).

DISCUSSION

This study aimed to examine the effectiveness of the ten-week series in repetition of TABATA workouts in the improvement of the Body Mass Index (BMI) and Waist Circumference (WC) of the participants. Based on the findings, it was found that there was a significant difference and improvement in the body mass index of the participants if seen from an overall perspective. The finding of this study has been supported by the study of (Domaradzki et al., 2020) which reported that a significant difference was observed in the BMI of the participants who joined the 10-week TABATA program after performing the two-way ANOVA [BMI(F=120.30,p <0.001)], however, it is only effective for overweight individuals. Likewise, the findings of Meng et al. (2022) also reported that BMI and body fat mass decreased (BMI: −1.8 kg/m^2 vs. – 1.2 kg/m^2, P < 0.01; FM: −1.6 kg, P < 0.05 vs. -3.7 kg, P < 0.01) in HIIT following the TABATA program for twelve weeks. Similarly with the study findings of Lu et al. (2023), it was reported that a 12-week low-volume TABATA style functional HIIT was highly effective to female university students to improve cardiorespiratory fitness, body fat, cardiometabolic health outcomes, and habitual PA. Contrary to the findings of Popowczak, Rokita, and Domaradzki (2022), based on their experimental study focusing on a 10-week PE curriculum supplemented by TABATA training program to secondary school students, it was observed that male students of the intervention group has significantly reduced their body fat (1.77%, p < .05) compared to their counterparts. Additionally, the study of Juránková et al. (2015) has reported that the ten-week program of high-intensity strength interval training has a positive effect that is not statistically significant on the reduction of body fat but has a positive effect that is statistically significant on the increase of muscle mass. Based on the general findings, it can be postulated that participating in the TABATA program is effective and may partially improve students' body mass index.

On the other hand, concerning waist circumference, it was found that a significant difference and improvement were observed as seen in the participants' before and after scores. Alarmingly, for male participants, the results showed no statistically significant change in test scores concerning their Body Mass Indexes before and after the TABATA workout, but there is a slight significant improvement in waist circumference. When compared to female participants' pre and post-test scores for BMI and waist circumference, a statistically significant difference was found. Based on these findings, supported by the study of N. Shah and Purohit (2020), reported that TABATA training shows significant improvement in reducing the waist circumference of the female participants. In this regard, it can be postulated that TABATA training program demonstrated partial effectiveness but should be individualized and sex differences should be highly considered in relation to the improvement of waist circumference. In general, there have also been various studies in relation to the effectiveness of TABATA program as HIIT in decreasing and improving waist circumference. Such as the findings of Saetang and Silalertdetkul (2021), it was found that after training, both the HIIT and Abdominal groups saw a substantial reduction in body fat percentage (p <.05). However, only the HIIT and Abdominal groups saw a reduction in their combined abdominal skinfold, waist circumference,

and waist-to-hip ratio after training (p <.05). Likewise, the study of José De Menezes-Junior et al. (2020) has found that children who are overweight or obese can benefit from HIIT protocols with work-to-rest ratios of 1:1 or 2:1 regardless of the overall amount of time spent exercising. In this regard, it can be posited that the TABATA workout may effectively reduce and improve the waist circumference of the participants for those falls under the overweight and obese. Notably, multiple studies have confirmed that TABATA workouts are extremely beneficial, especially for those who are overweight, or obese. Such as the study of D'Amuri et al. (2021), it was reported that a 12-week HIIT is significantly effective for obese adults. Similarly, with the findings of Taufikkurrachman et al. (2020), observed that TABATA method represents an effective way in reducing body weight and fat, most especially to those overweight and obese individuals. However, based on the results of the study, TABATA training program is not highly suggested to introduce, most especially for students that falls under the underweight category as this may cause detrimental issues concerning their health. On a positive note, the training program may be suggested to underweight students if combined with proper caloric food intake.

CONCLUSION

Based on the findings of the study, it has been observed that a 10-week TABATA training workout in repetition may partially improve students' body mass index and significantly enhance waist circumference. In this regard, PE instructors of the college may continuously utilize this exercise in order to facilitate a positive, healthy, and enjoyable activity that may lead to the improvement of their BMI and WC. Furthermore, it has been found that this HIIT program may be highly effective for female college students compared to their counterparts, specifically for both BMI and WC improvement. However, the findings of this study are based on its significant observation that it is highly applicable for students that falls under the category of overweight and obese, but not recommended for those underweight. Additionally, as have mentioned earlier in the discussion part, this type of workout program should be individualized and difference in terms of sex should be highly evaluated.

Most importantly, this experimental study has some caveats that needs to be taken into consideration. This study only focused on undergraduate students in a college in the Philippines. Therefore, this study may not be able to extrapolate the effectiveness of the workout program to other student population. In this regard, the findings of this investigation indicate that doing a similar study with the participation of other students from other higher educational institutions is strongly recommended. Lastly, this research did not take into account the participants' dietary habits, lifestyle choices, and other factors which may also affect the result of this study. Ergo, it is highly suggested that comparable experiments be conducted while taking into account the other variables that were mentioned previously. In conclusion, this study makes a novel contribution to the existing body of information in the form of knowledge about the efficiency of the 10-week TABATA workout program in repetition to undergraduate students in a college in the Philippines

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